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cylinder which supports the Dome itself. The Dome weighs about 100 tons and is about 74 feet in diameter (that is, it is of essentially the same dimensions as the Dome at Mount Hamilton). The cost of the metallic part of the Dome was about $40,000 (that of the Lick Observatory, which is of about the same dimensions, was about $53,000). The design is due to M. EIFFEL, who has introduced at least one decided novelty. The Dome can be made to revolve on a live-ring of the GRUBB system (like that at the Lick Observatory) and it can also be raised off the wheels of this live-ring and have its entire weight supported by a hollow metal tank floating in another tank, which is intended to contain a non-freezing mixture. The printed accounts describe the working of this Dome as highly satisfactory. It may be of interest to add here that the Dome at Mount Hamilton has been in constant use since July, 1888, and that not a single night's observation has been lost through any stoppage for repairs or adjustments to the Dome or shutters.

The Nice Observatory is magnificently equipped with equatorials of 30 and 15-inch aperture (objectives by the MM. HENRY of Paris) with a fine meridian circle by MM. BRUNNER frères, etc., etc. It is no part of the plan of this brief note to describe the admirable observations and memoirs which have already come from the Observatory of Nice. A note on the latest volume issued will be found in these *Publications* vol. III, page 45.

The Observatory is, with the exception of that of Pulkowa, the best equipped in Europe; and it should not be forgotton that it is the gift of a single individual, to whom science owes a great debt.

E. S. H.

EXTRACTS FROM LETTERS WRITTEN BY GEORGE P. BOND OF HARVARD COLLEGE OBSERVATORY, 1857-1860.*

SEPTEMBER 28, 1857.

To G. B. AIRY, Astronomer Royal.

* * * * "My father† requests your acceptance of the enclosed plate exhibiting a line photographed by α *Lyræ*, as it passed the field of the equatorial by its diurnal motion, the telescope remaining fixed. You will perceive that your idea for the self-registration of transits and zenith distances can be perfectly realized for this particular star.

"You will notice considerable fluctuations in the intensity and regularity of the line, to be ascribed partly to changes of refraction, partly perhaps to the fact that contiguous portions of the plate are not equally sensitive to the action of light; but it is possible that the phenomenon of *twinkling* may have some part in determining the character of the line traced by the star.

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* Kindly communicated by his daughters, Miss ELIZABETH and MISS CATHARINE BOND of Cambridge, Massachusetts.

† *i. e.* Professor WILLIAM CRANCH BOND, then Director H. C. O.

"It seems now highly probable that, by taking advantage of the aids which the art of photography has placed within our reach, a grand impulse might be given to astronomy. By the employment of electro-magnetism the astronomer has been relieved from dependence upon the sense of hearing and the mental faculties which used to be called into exercise in estimating small fractions of time. Photography may be enlisted in aid of, or even as a substitute, for the eye.

"It is to be supposed that these first attempts are susceptible of great improvement. We can certainly have larger telescopes. I believe that a liberal expenditure of money will solve all the mechanical difficulties in the way of constructing a telescope of four times the aperture of ours. We should then photograph ***instantaneously*** stars $\frac{1}{16}$ as bright as α *Lyræ* and, as I estimate, in less than one minute, stars of the 8th or 9th magnitude, without reckoning upon any improvement in the preparation and treatment of the plates. Certainly we have a right to expect much from chemistry in furtherance of the same end.

"We have also yet to try the effect of using the telescope in a purer atmosphere; on an elevated mountain, for instance."

MARCH 31, 1860.

To J. INGERSOLL BOWDITCH, of Boston.

(In this letter the pressing need of money for the Observatory is forcibly urged, for current expenses, for printing the Annals, etc.)

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"The application of photography to astronomical purposes stands greatly in need of further development. It has already afforded most valuable results, and there is every reason to suppose that it will, one day, become a great power in the investigation of the most interesting problems of astronomy.

"The cost of materials in photographic experiments is one of the principal reasons why the subject has not hitherto been pursued further [here]. It would be certain to repay the outlay if an astronomer of experience, furnished with a good telescope and photographic apparatus, should visit different parts of the world (high table-lands and mountains), and experiment on the advantages of a pure and tranquil atmosphere. It is understood that photography succeeds better in California than here, and better here than in Europe. Now a few essays in California, at an expense of a few thousand dollars, might prove of inestimable advantage to the science.

"The Russian Government has just appropriated nearly $40,000 for an expedition to Persia to try the effect of a pure atmosphere on the visibility of celestial objects, but they make no mention of the most important means of extending our researches, namely, photography. Why should we always have to wait for the example of the Governments of Europe in the encouragement of scientific enterprises? If our observatory had possessed the means, we should have sent off an expedition of this kind, years ago; it was actually proposed, but of course nothing could be accomplished without money. We might now, with equal means, get our expedition to the interior of California, secure the best of results, and get back before the Russians have started."

JUNE, 1859.

To R. C. CARRINGTON, Secretary of the Royal Astronomical Society.

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"I have long thought that there was a kind of sympathy in the photographic action, light acting at one point rendering neighboring points more sensitive, and that possibly a star image slightly out of focus might 'take' quicker than when reduced to a minimum area. If this theory be true, then a poor telescope would be better than a good one, which would be introducing a new principle into practical astronomy!" * * * *

FEBRUARY 29, 1860.

To R. C. CARRINGTON.

* * * "I noticed the unexpectedly rapid action of *Jupiter* in photography on the first occasion that it was taken, nine or ten years ago. On March 22, 1851, I find the following memorandum referring to the time of exposure of the plates. It is noted that it was 'About as long as the moon required, or not much longer.' We have since confirmed this on several occasions, and DE LA RUE comes to much the same conclusion. Within a month or two past, I have engaged Mr. WHIPPLE to photograph the sun, moon and *Jupiter*. The central regions of ☉ and ♃ have decidedly the most intensity, whereas the margins of the moon act first. A photograph of a cannon ball painted white was more uniform in action than either of the three above-named objects, but it most resembled the moon. ARAGO mentions a similar result for flat discs. *Mars* is brightest on the limbs, and *Venus* also; but the latter, not being seen in opposition, does not furnish as safe a comparison as ♂ or ☾. Thus far then,

we find that ♃ and the 🌕 rank together in the *distribution* of light on their surfaces.

"Sunlight at ♃ is $\frac{1}{27}$ of the intensity that it is at the earth or the moon, and we should expect, with a similar reflecting surface, that ♃ would show only about $\frac{1}{27}$ of the chemical intensity of the moon, whereas its central parts almost equal the average surface of full moon. (The intensities are in the ratio of 4 to 5, about). So we must suppose ♃ to be either *chemically* self-luminous, or else that it has a very peculiar property of light, reflection affording $\frac{4}{5} \times 27 = 22$ times actinic intensity of moon-light. This may be possible; its surface presented to us is gaseous, the moon is solid.

"The spots, or faculæ, on *Jupiter* remind us of the sun, and it is curious to notice how the discordances in the sun's rotation from proper motion of spots is paralleled in the case of ♃'s rotation, which fluctuates between $9^h\ 50^m$ and $9^h\ 56^m$, a very decided inequality. Then again, the question of the recurrence of spots in the same region is not established, though suspected with both bodies.

"The arrangement of sun-spots in zones and their prevalence in low latitudes, accords with *Jupiter's* belt action.

"I have seen ♃'s bright regions mottled like the sun, and compared the two to each other, years ago. ♃'s spots are sometimes not dusky simply, but *black*, at any rate so-called, though we must not lay too much stress on an expression adopted perhaps hastily. The transit of *Jupiter's* satellites as black spots I have often witnessed. These always enter and pass off *bright*, as seen projected on the margin of the disc. The old explanation, which attributed the appearance to dark spots on the satellites, will not meet the facts, by any means. The first satellite is not black, or even always dark, excepting on a bright zone.

"The grand objection to the idea of *Jupiter's* self-luminosity is the darkness of the shadows cast by the satellites, but it is a question how much defect of light in an object projected on a bright background will cause it to look black, especially when it subtends only a very small angle.

"Perhaps if the side of *Jupiter* turned away from the sun be bright, we ought to see the satellites in eclipse. Here is another difficulty. Then again SEIDEL makes *Jupiter*, *Venus* and *Mars* have equal "Albedo," which militates against the idea that *Jupiter* is any more self-luminous than *Venus*, for instance. I think there must be an error in the monthly notices of the Astronomical Society for January 1860, page 102, as regards the Albedo of *Saturn* and *Mars*.

The latter is fainter than *Saturn*, allowing for distance from sun and areas of illuminated surface.

"I have been looking into the relation between the period of sun-spots and the position of the principal planets as, in case of extensive chemical action going on in their atmospheres a reflex action on the sun, a sympathy between them, might be anticipated. At first all was promising up to 1826, as *Jupiter's* perihelia and aphelia answer tolerably to maxima and minima of spots, but previous to 1826 there is too much divergence. * * * *

"At all events, *Jupiter* should be studied henceforth with special reference to the relation between the physical constitution of its atmosphere and that of the sun."

GRANT TO THE LICK OBSERVATORY FROM THE SMITHSONIAN INSTITUTION.

The Smithsonian Institution, through its Director, Professor LANGLEY, has granted to the Lick Observatory a sum of money sufficient to provide a portion of the apparatus to be used in making enlargements of the Moon with the photographic object-glass of 33-inches aperture.

Experiments in this direction are already in progress. E. S. H.

HARVARD COLLEGE OBSERVATORY EXPEDITION TO THE SOUTHERN HEMISPHERE.

The following paragraphs from the New York *Herald* give one of the best accounts of this expedition which has so far appeared in print:

"The Harvard Observatory's expedition to Peru is on the eve of setting out—probably the best equipped, as it is to be the most comprehensive, scientific expedition ever sent forth.

"In prosecuting its self-assumed task of making a complete map of the heavens, the observatory has found it necessary to establish branch stations in order that the entire sky may be mapped, and, for this purpose, an astronomical plant has for some time been in operation on Wilson's Peak in Southern California. In May, 1889, a similar station was erected at Chosica, Peru, and there S. I. BAILEY and M. H. BAILEY, two of Professor PICKERING'S lieutenants, have been at work systematically observing the southern hemisphere of stars. The observers at Cambridge have done all that they can do in this line—that is, they have located and described all the stars which